IMPLEMENTATION OF VALUE STREAM MAPPING IN AN AUTO PARTS INDUSTRY OF PUNJAB: A CASE STUDY

ARVIND KUMAR SHARMA

Summary

Purpose – The motive of this paper was to explain how value stream mapping (VSM) is helpful in removing non value added activities from the industry and achieving lean production system after implementation and to bridge the gap between the current state and the proposed state of a manufacturing firm.

Design/methodology/approach – The current state of manufacturing was mapped with the help of VSM process symbols and the biggest improvement areas like excessive operations, excessive manpower, lead time, cycle time, are identified. TAKT time was calculated. Some improvements in current state map were suggested and with these improvements, future state map was prepared.

Findings – Current state map and future state map were compared and resulted into: 12.89% reduction in processing time, 13.33% reduction in total number of operations, 7.73% reduction in WIP, 25% reduction in manpower requirement, 4.7% reduction in lead time and the profit to the company is Rs. 340200 annually.

Practical implications – Value Stream Mapping (VSM) is an important lean tool applied in industries to continuously improve functioning and manufacturing excellence of an industry and it also leads to the lean production system.

Originality/value – This paper was a real case study showing VSM implementation in achieving lean production system.

Keywords Lean production, Work in progress, processing time, manpower, number of operations, Lead times

I. INTRODUCTION

Many manufacturers are applying lean principles to eradicate wastes and increase efficiencies. Lean manufacturing is a Japanese approach that focuses on eliminating wastes, whilst ensuring quality. The aim of lean manufacturing is to cut unnecessary costs by making the business more efficient and responsive to market needs. The primary idea of this system is to maximize value while minimizing waste, thereby achieving manufacturing excellence through the creation of maximum value with fewer resources. Lean manufacturing may be defined as a set of techniques which are used to reduce and eliminate the wastes. This will make the company leaner, more flexible and more responsive by reducing waste (Wilson, 2009). It is the systematic approach of identifying and eliminating waste through continuous improvement by flowing the product or service at the pace of customer (Nash et al., 2006). The Value stream mapping (VSM) is one of the lean tools used to find wastes in the value stream of a product. Once waste is identified, then it is easier to make plan to eliminate it (Rother and Shook, 1998). The purpose of VSM is process improvement at the system level. However, in addition to the information normally found on a process flow diagram, value stream maps show the information flow necessary to plan and meet the customer’s normal demands. Other process information includes cycle times, inventories, changeover times, staffing and modes of transportation etc. The key benefit to value stream mapping is that it focuses on the entire value stream to find system wastes and try to eliminate the pitfall. Generally, the value stream maps involve two maps. Current state map tells about the current situation, future State Map can be obtained by removing non value added activities from Current state map. The VSM is designed to be a tool for highlighting activities. Once the wastes are highlighted, the purpose of a VSM is to depict the opportunities so they may be prioritized and acted upon.

II. LITERATURE REVIEW

VSM is a powerful tool of lean manufacturing and allows industry to understand and continuously improve its understanding towards lean. It provides a clear picture of various non-value adding and value adding activities in the value stream of the product. VSM helps us in reducing or eliminate non-value adding activities or wastes by allowing us to apply various lean techniques. Singh & Sharma (2009) presented a paper to explain how value stream mapping was helpful for the removal of various types of wastages in the manufacturing system. The authors mapped current state map. Further, TAKT time was calculated. Then, future state map was prepared. Current and future state maps were compared and resulted into; 92.58% reduction in lead time, 2.17% reduction in processing time, 97.1% reduction in WIP and 0.08% reduction in workforce. Osama (2010) presented a paper in which the Value Stream Mapping (VSM) was applied in the service sector in Libya with the purpose of eliminating wastes and...
increasing capacity. The results achieved showed significant improvements in the performance of the system, which were more productive, flexible, smooth and with high quality service. Vinodh et al. (2010) applied Value Stream Mapping (VSM) approach in an Indian Camshaft Manufacturing Organization. The current state map was developed. After the identification of improvements in the current state map, a future state map was developed. The results of the implementation study indicated significant improvement in lean characteristics. Singh & Singh (2012) addressed that lean manufacturing had been proved to be an effective management philosophy for improving businesses. The work had been carried out at a typical tractor industry which showed 50.5% reduction in total lead time in future state value map and the number of operations involved was reduced from 22 to 18. Rahani & Ashraf (2012) discussed case study where the Value Stream Mapping (VSM) was used. A current state map was made. Then a future state map was made. The contrast of the before and after the LP initiatives showed benefits such as reduced lead-time and lower work-in-process inventory. Pandhi & Verma (2012) attempted to identify and eliminate different types of wastes with the application of lean tool (VSM) in an automotive industry. The authors selected Gearbox case machining due to high economic value and complicated processing cycle resulting into excessive rework, longer lead time, and high rejection rate.

III. COMPANY PROFILE

This case study was carried out in the XYZ industry. The industry is an auto parts industry. The company was established in 1938. The company is a quality oriented which has got TS-16949 certificate for continuous improvement in quality.

IV. PRESENT WORK

A. TAKT TIME CALCULATION

The time needed to complete an operation in a process should be less than the takt time in order to product to be completed within the allotted time. Takt time is the number of work minutes per day divided by the number of orders per day.

- Demand = 400 pieces per shift.
- Available working time = 480 - 60= 420 min’s per shift (Excluding 30min’s of lunch time, two fifteen min’s break time from 8hrs of shift).
- Effective number of days = 25 days (Sunday sand gazzated holidays excluded)
- Number of shifts per day = 3

\[
TAKT\ TIME= \frac{420}{400}= 1.05\ MIN= 63\ SEC
\]
V. CURRENT STATE MAP

All the data was collected for current state map by using VSM tool. The order comes from the customers to planning department of XYZ Company. Then planning department conveys this information about requirement to different suppliers by manually or by electronically media. The material moves from raw material store to finished items store through a number of processes including Band saw cutting, CNC, raw grinding, cross hole drilling, counter sinking, reaming, stamping, case hardening, tempering, reaming, outer grinding1, outer grinding2, outer grinding3, final inspection, packing. WIP Inventory in between the stages was shown in triangles. The timeline at the bottom of current state map includes, production lead time and processing time or value added time. Value added time was calculated by adding the processing time
for each process in the value stream. This current state map provides a picture of existing or present positions and shows the gap areas in the value stream.

VI. ANALYSIS OF CURRENT STATE MAP

- There was one operation having cycle time above the takt time. The operation with cycle time above takt time was Band saw cutting.
- Apart from the above mentioned operation, there were some other areas (viz. Outer grinding operations & also Packing operations) in the process of king pin production that were very well covered under the takt time but were contributing towards waste; and were areas of concern for improvement to be carried on.

  - The production lead time was 89hrs.
  - The work in process inventory was also very high in between operations having 1940.
  - The total workforce involved was 20.
  - The total numbers of operations involved were 15.

So, it had been observed that significant scope for improvement was there.
VII. PROPOSED CHANGES FOR FUTURE STATE MAP

Some changes were proposed for the future maps which are as follows:-

1. BAND SAW CUTTING:
   Band saw cutting operation involved 84.6sec of cycle time having:
   Loading time = 54sec/single rod.
   Value added time = 27.6sec.
   Unloading time = 3sec.
   The loading time was very much high. So, the main consideration was to reduce loading time. Previously, loading was done manually by the workers. By incorporating remote operated Electric hoist sling type system, this non value added time can be reduced to a great extent.

2. OUTER GRINDING OPERATIONS
   Previously, there were three grinding operations which were carried out separately of one another including outer grinding1, outer grinding2, outer grinding3 in the process of king pin. This resulted in the wastage of time and manpower. By clubbing these three outer grinding operations through Roller conveyers, there will be a large benefit to the company including, reduction in workforce, and reduction in processing time.

3. PACKING SECTION
   Previously, in the packing section, there were four operations in the packing section and were performed by four workers. The various operations performed in packing process were as follows:-
   1. Picking and handing over the king pin
   2. Putting the king pin in polythene pack one by one
   3. Placing of filled polythene packs in a box
   4. Sealing of the box
   After critical observation of packing section, the second and third operations can be combined into one operation. The benefit of this combination had been reduction in the number of operations of packing process as well as workforce.

VIII. FUTURE STATE MAP

From the proposed changes in the current state map, a future state map was developed. Future state map depicts the various proposed changes incorporated in the manufacturing process of king pin. Future state map looks different as from current state map as it includes various proposed changes. The information contains in the future state was as follows:-

1. Reduction in the total number of operations of king pin production process. Operations were reduced from 15 to 13.
2. Outer grinding operations viz. outer grinding1, outer grinding2, outer grinding3 were reduced to a single operation.
3. The processing time was reduced from 558.8sec to 486.8sec.
4. Workforce was reduced from 20 to 15.
5. Work in process inventory was reduced from 1940 to 1790.
6. Lead time is reduced from 89hrs to 85hrs.
TAKT TIME = 63 SEC

FUTURE STATE PROCESSES AT DIFFERENT STATIONS

- band saw cutting
- cnc
- raw grinding
- cross hole drill
- counter sinking
- reaming
- stamping
- case hardening
- tempering
- reaming
- outer dia grinding 1,2,3
- final inspection
- packing
### IX. CONCLUSIONS

<table>
<thead>
<tr>
<th>S.NO</th>
<th>Performance measures</th>
<th>Current state map</th>
<th>Future state map</th>
<th>Percentage reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Processing time</td>
<td>558.8sec</td>
<td>486.8sec</td>
<td>12.89%</td>
</tr>
<tr>
<td>2</td>
<td>Lead time</td>
<td>89hrs</td>
<td>85hrs</td>
<td>4.7%</td>
</tr>
<tr>
<td>3</td>
<td>Work in process inventory</td>
<td>1940</td>
<td>1790</td>
<td>7.73%</td>
</tr>
<tr>
<td>4</td>
<td>Workforce</td>
<td>20</td>
<td>15</td>
<td>25%</td>
</tr>
</tbody>
</table>

| 5    | Number of operations  | 15                | 13               | 13.33%               |

1. Processing time for manufacturing the king pin was reduced by 12.89%.
2. Numbers of operations were reduced by 13.33%.
3. Manpower requirement was reduced by 25%.
4. Work in process inventory was reduced by 7.73%.
5. Lead time was reduced by 4.7%.
6. Profit to the company was 340200 rupees annually.